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ANATOMY AND PHYSIOLOGY OF
EXPRESSION

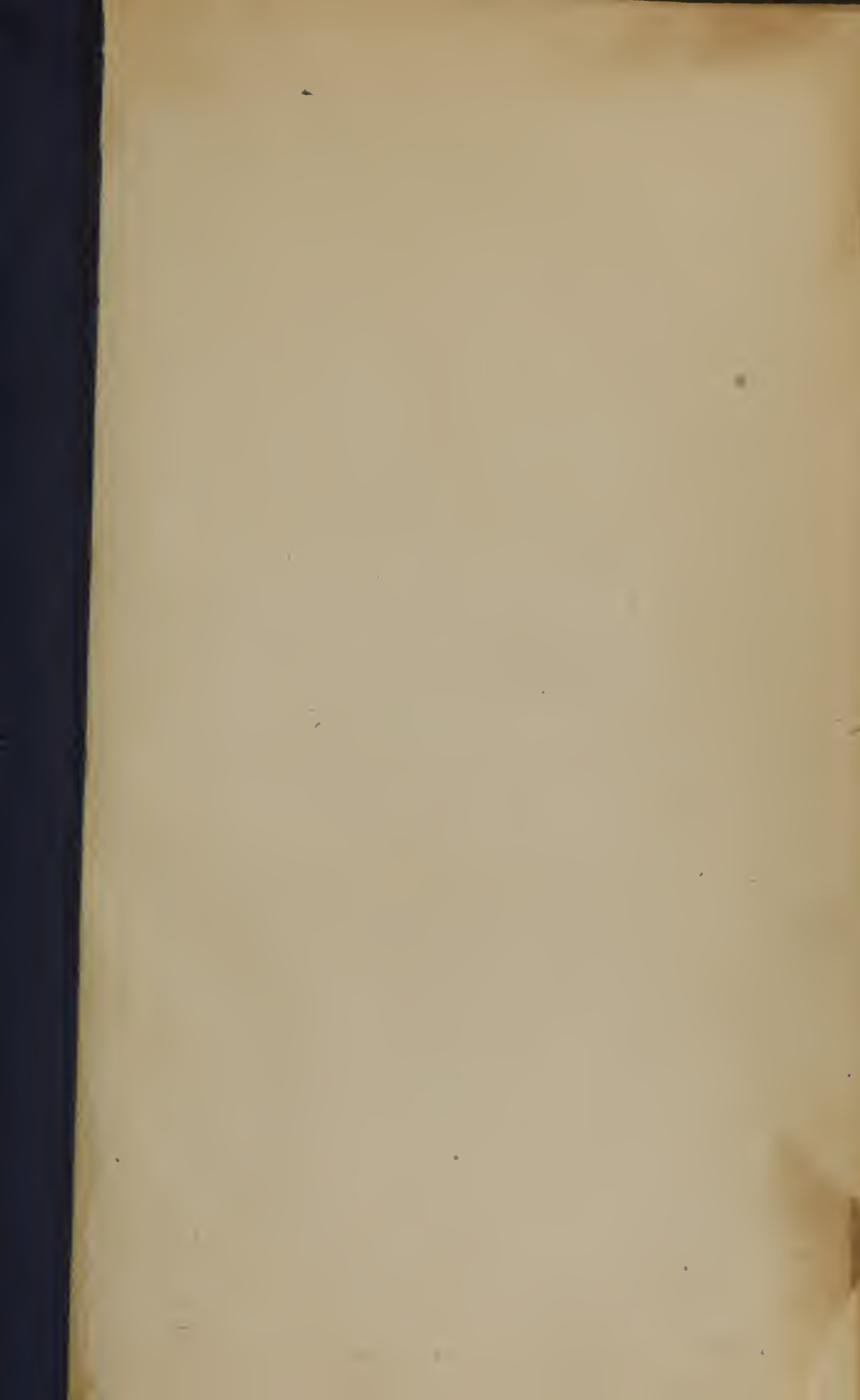
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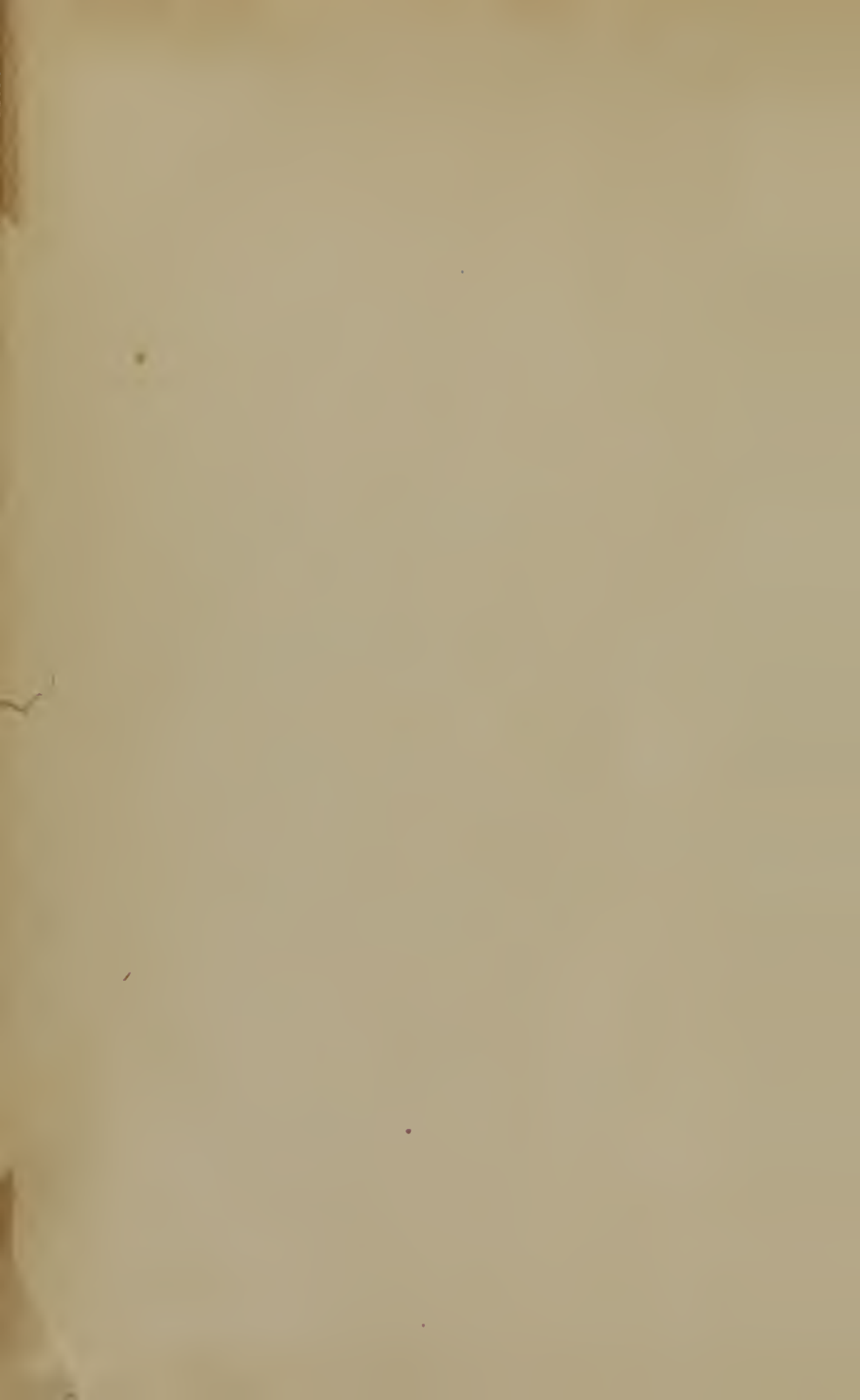
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THE

ANATOMY AND PHYSIOLOGY OF EXPRESSION,

AND THE

HUMAN TEETH

IN THEIR

RELATIONS TO MASTICATION, SPEECH, AND APPEARANCE

Two Addresses.

BY

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PREFACE.

THE accompanying Addresses may be said to have had their origin in a communication published by me in the DENTAL COSMOS, in connection with an extract from an article by Prof. Oliver Wendell Holmes, on "THE DOINGS OF THE SUNBEAM," presented in the *Atlantic Monthly*. My remarks were as follows:—

"When it is remembered that within the few square inches comprised by the human face, room is found not only for traits of all of one's ancestors, but also that the cares and anxieties, the joys and sorrows, the hopes and fears, and the moral, mental, and social associations and trainings of the past of a person, leave ineffacable traces, which are perceptible to the most obtuse, if they will exercise their perceptive faculties, and which enable the keen and philosophical observer to form a *fair* estimate of the past experience and present and future capabilities of the individual, it is not a matter of surprise that Lavater, and others, who have made the human face a special object of study, should have been so enthusiastic with regard to it. Moore, it is true, has said—

"'In vain we dwell on lines and crosses,
Crooked mouths, or short proboscis:
Boobies have looked as wise and bright
As Plato, or the Stagyrte;
And many a sage and learned skull
Has peeped through windows dark and dull.'

"While this is undoubtedly true in exceptional cases, there is more of poetic imagination than actual truth in a broad application of such assertions; for there is almost invariably associated with high moral and mental manifestations, or the reverse, an unmistakable evidence of the fact on the brow of the person. It may not be evident at a first and superficial glance, or when the features are in repose; but the spirit

which brings the muscles of expression into action speaks through them in a language not easy to be mistaken.

"All persons, from the lisping babe to the hoary patriarch, are more or less physiognomists; in other words, are attracted or repelled by the expressions of the face. With the many, the impressions formed are instinctive and emotional in their character, rather than the results of calm and philosophical reasoning. The opinions arrived at under the former conditions of mind, as a general thing, are not very reliable, and are apt to be abandoned as quickly as they were adopted, and are quite as unimportant in their results as hasty conceptions generally are; but those whose duties bring them in contact with large numbers of their fellow-beings must, of necessity, depend in a great measure on the physiognomy for an estimate of the character and capacities of those who come before them as strangers for a brief period only; and while it would not do to rely implicitly and irrevocably on such data, a person of large experience, possessed of fair perceptive and reasoning faculties, is not likely to be led far astray in his conclusions.

"It is not merely as a means of forming an estimate of character that the face becomes an interesting and important object of study. To the artist, whether as a sculptor or a painter, who aims to excel as a delineator of nature, it recommends itself with peculiar force. Every one's attention is liable to be attracted by strongly-marked and characteristic features. A high and expanded forehead, a prominent nose, and dark and expressive eye, or a mouth indicating firmness of purpose, are not likely to escape observation and comment; but to perceive and retain in the memory those fine shades of difference which exist between the mass of faces, (that are so much alike, and yet so dissimilar,) and delineate them in marble or on canvas so perfectly that there can be no question as to the resemblance, requires peculiar natural gifts, combined with long-continued and careful study of the face during life, when by the action of the muscles of expression it is constantly undergoing a thousand and one changes, and by frequent dissections of the cadaver to ascertain the size, shape, origin, and insertion, and the relations which these muscles bear to one another and the surrounding parts.

"To no one, however, does the study of the human face, in its various forms and aspects, recommend itself with more force than to the dental

practitioner; for, called upon as he is, not only to relieve suffering humanity from the greatest pain to which flesh is heir, but also to repair the ravages of decay, either in efforts directed toward the preservation of the natural organs, or, when these are lost, to supply artificial substitutes, if he is not as quick to perceive and as able to retain in his memory the nice shades of expression of the same face, and the characteristic points of resemblance or difference between various individuals as the sculptor or painter, he will fail in many essential particulars to meet all the just and proper demands upon him.

"A practitioner always on the watch, and quick to perceive the slightest change of expression in the face of his patients when operating in the neighborhood of an exposed pulp, or in administering an anæsthetic, will be much less likely to give unnecessary pain, or bring life in jeopardy, than those who are indifferent in regard to such matters. Again, it is not reasonable to suppose that a symmetrical and natural appearance can be given to teeth much broken up by decay, when the effort to file or fill them is intrusted to one who has not paid due attention to the form, position, and relations of the dental organs in their normal condition; or that such a one can arrange and insert artificial substitutes with any certainty that they will preserve or restore the old and familiar expressions of the face, so well remembered and possibly admired by friends and acquaintances. Opportunities, indeed, are sometimes offered, requiring little or no effort to improve the appearance by the introduction of artificial teeth; but to accurately meet the varied complexions and forms of face which present themselves, so that the results shall prove faultless in their adaptation, is deserving of the highest meed of gratitude and praise on the part of the patients.

"As the most careful observers and the best judges of what constitutes a natural expression, can only form an approximate estimate of the expression of those whom they are called on to serve after the loss of natural teeth, it is reasonable to infer that valuable assistance would be found by bringing in the aid of photography to determine nice or doubtful points under such circumstances. Indeed, as the memory of man is so treacherous, it would be of assistance even in cases where the face is long and well known to the operator. At a period when photographs are so much in vogue that they are used as "*cartes de visite*," and when it is the

exception where persons have not sat for their picture, the dentist will have little or no difficulty in securing full-face, quarter-face, and profile views of patients taken long before the loss of the teeth. With these in hand, the skillful and artistic practitioner will be able to preserve or restore, or if need be improve, the old and familiar expressions."

In connection with this, by permission of the author, the following note is presented:—

"BOSTON, *September 28, 1863.*

"DEAR SIR: Many thanks for the two numbers of the DENTAL COSMOS, and for the compliment paid an article of mine by taking it as the text of your interesting remarks. The subject is one of great interest, and will, I hope, receive a fuller development at your hands hereafter.

"I am, dear Sir,

"Yours very truly,

"O. W. HOLMES."

In giving the subject a "fuller development," my aim has been to treat it in a suggestive manner, so that a spirit of inquiry might be awakened in a direction not only attractive and instructive in its nature, but also capable, if the information gained is rightly applied, of being made subservient to the comfort and happiness of others.

Within the limits of two brief addresses it was of course impossible to enter upon the minuter description of structure, or to make that extended practical application of which the subject is susceptible. This can only be done in a regular and systematic course of lectures. Recognizing the importance of such a course, it has ever been my practice, as a public teacher, to present these and analogous subjects to the attention of students in the broadest, most extended, and practical manner possible, in my winter course of lectures on ANATOMY, PHYSIOLOGY, AND HYGIENE.

J. H. MCQ.

1112 ARCH STREET, PHILADELPHIA,
July, 1864.

THE ANATOMY AND PHYSIOLOGY OF EXPRESSION.

An Address delivered before the Odontographic Society.

Gentlemen:—As the essayist of the evening, having no paper ready to present, my remarks of necessity will be of an oral character. The subject I have selected for your consideration is one which should, and more or less actually does, interest everybody; for although on the part of the many there may not be a recognition of the fact, every one is somewhat of a physiognomist; or, in other words, intuitively seeks within the few square inches of the “human face divine,” to discover the mental and social qualities and past experiences of those with whom he is brought in contact, by the relations of business or pleasure. And there the indelible record is made of the mental training, the high and ennobling, or the low and degrading association, and the joys and sorrows each individual being has experienced. Erroneous estimates may be, and frequently are made by the most acute observer, but this is no evidence that the most legible and unmistakable record was not presented in each instance. An opinion of any value is not to be formed by carelessly and indifferently observing the features when in *repose*, or *noting a few changing expressions*; but by a careful and philosophical examination under *all their varying* and *chameleon-like* forms. A false estimate of character may sometimes be due to the fact that the opportunities and circumstances attending the examination have not been of such a nature as to disclose all the face was capable of revealing; for as a *single word* often gives a clear insight of the life and animus of an individual, so a *single look*, indicative of love or hate, hope or despair, will reveal traits of character which the individual fully recognizes the possession of, and studiously endeavors to conceal from the observation of the world.

Aside from this general interest shared by all in the human face, it is important that those engaged in certain departments of life should become thoroughly acquainted with the mechanism, so to speak, by which the record is made. To the speaker, whether in the pulpit, at the bar, or on the stage, *gesture* is all-important; to the artist, whether as a

painter or sculptor, *expression* is everything; and last, though not least, to the dentist a faithful discharge of duty demands that he should, in the performance of his operations on the teeth, invariably endeavor to *preserve* the natural expression of the face, or when the ravages of decay have eventuated in the loss of the dental organs, that the lost expression should be *restored* by the introduction of properly constructed and adapted artificial substitutes. To each and all of these, and particularly to the latter, if they desire to attain the highest possible point of excellence, an intimate acquaintance with the ANATOMY AND PHYSIOLOGY OF EXPRESSION is indispensable. In the brief space allotted to me this evening, little more can be done than to offer, in a general manner, the groundwork on which such an interesting and extended study rests. It would require many evenings, and fill a large sized volume, to do full justice to the theme. With this understanding, permit me in the first place to direct your attention to the main characteristics of the bony framework on which the features rest, for in the language of Tennyson,—

“Every face, however full,
Padded round with flesh and fat,
Is but modeled on a skull.”

The roundness and fullness of some faces, the sharp and pinched appearance, or the long and heavy expression of others, is mainly due to the shape and size of the bones on which the features are moulded. In illustration of this, you see on the table a number of craniæ, ranging from the earliest period of infancy to childhood, adolescence, manhood, and extreme old age; and in addition, others belonging to different races, each and all indicating, in a marked degree, the characteristic differences just referred to. In this, for instance, the skull of an infant a month or so after birth, all that portion which contained the brain is relatively large, with a full forehead, but rather flat at the eyebrows, while the bones of the face are diminutive, and their external surface smooth and rounded; no great prominences and depressions, with the exception of the orbital cavities, are presented, and everything contributes to give the plump and meaningless expression characteristic of an infantile face while in repose. Passing to another skull belonging to a child æt. six, the bones of the face are found largely increased in size, and this, along with the presence of the deciduous teeth, serves to lengthen the face, and make it less round than that of the infant. The gradual but marked increase of size in the superior maxillæ presented in these skulls, as we pass from infancy to childhood, from childhood to adolescence, and from adolescence to manhood, is accompanied by a proportionate enlargement of the Antrum Highmorianum; at the same

time, as the centre bones of the face, their growth has the effect of increasing the length and prominence of the nasal and malar, or cheek bones. The presence of the large permanent teeth of the adult, and the alveolar processes which support and fix them, serve also to increase the length, breadth, and depth of the superior and inferior maxillæ; and the entire face consequently becomes larger and longer, but not necessarily fuller. In the great majority of cases, indeed, along with the increased size and lengthened visage, there is a decided and proportionate loss of the roundness and fullness presented in the infantile period. The reason for this is obvious, when observing the great prominence of the nasal and malar bones, and the corresponding depressions in the other parts of the face, particularly the canine fossæ of the superior maxilla. In life, when these depressions are not well "padded round with fat," the cheeks of course present a wan and sunken appearance. In the series here presented, while the bones of the face have gradually increased in size, those of the cranium have maintained a proportionate relation. This prominent ridge in particular, (the supra-orbital,) in the frontal bone of this very fine and perfect adult skull, and which has much to do with expression, is owing to the gradual separation of the external and internal plates of the os frontis at this point, so as to form the frontal sinus. On this ridge the eyebrows rest, although they are usually described as resting on the superciliary ridge; but this is not correct.

It is generally conceded that the proportionate relation of the bones of the face to those of the cranium has much to do with the moral and mental qualities of the individual; in other words, that a high order of intellect is usually manifested by those in whom the cranium is large, the forehead broad and high, and the bones of the face small; while the animal propensities are generally evinced in a marked degree, and preponderate over the intellectual in those with depressed foreheads, compressed temples, and large and massive jaws, as in the case of this eminently prognathous skull of an African, with whose antecedents I was made acquainted by the gentleman who presented the specimen to me. The record in his case is in full confirmation of the position just advanced.

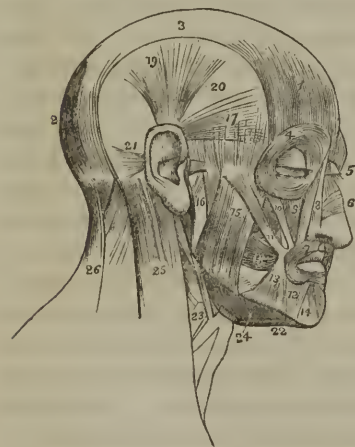
The opposite extreme is sometimes presented, in which the bones of the face are so disproportionately small, in comparison with the cranium, as to constitute a marked deformity. Again, a want of harmony between the different bones of the face is occasionally presented; as, for instance, when the inferior maxilla is very large and massive, or unusually small, in comparison with the superior maxilla, or vice versa. This hypertrophied or atrophied condition may occur in any of the bones, and of course when existing will mar the harmony of the surrounding parts.

In extreme old age, the atrophied condition of the jaws (markedly

manifest in this skull, belonging to a very old person) due to the gradual loss of all the teeth, and the absorption of the alveolar processes, produces that decided alteration in the features of the aged with which we are all so familiar. The change which invariably takes place in the angle of the lower jaw in consequence of the disappearance of the teeth and processes, causes the chin to project, and when the jaws are closed the nose and chin approximate each other. Even when apart, the falling in of the lips so encroaches upon the oral cavity as to make it too small for the tongue, and thus renders the speech feeble and indistinct. It is here where the skill of the mechanical dentist finds a field for artistic labor, not only by replacing the lost expression of the face, but also by restoring the medium through which the wants and thoughts of the individual are made known to others.

Arising from various parts of the bony framework, and then mainly converging to one or the other of the two great centres of expression, the eyes and mouth, there are a number of muscles on whose action the varying play of the features depends. Intending by no means to give, at this time, a lengthy and detailed description of these muscles, but rather to notice them casually, with the aid of the drawings, and the large papier-mache manikin here presented, I hope to make myself clearly understood. We will commence with

The *Occipito frontalis* (1, 2, 3,) consists of two broad but fleshy bellies, with an intervening aponeurosis resting upon the arch of the skull, and over which it slides; the posterior portion of the muscle arises from the superior curved line of the occipital bone. The principal parts of the anterior fibres are inserted, or blend with the corrugator supercilii, and the superior margin of the orbicularis palpebrarum. The minor portions of the right and left frontal muscles unite together some space above the root of the nose, and are inserted at this point and send down fibres which are continuous with the pyramidalis nasæ. *Function.* It moves the scalp, elevates the eyebrows, and induces the transverse wrinkles of the forehead.



The *Corrugator Supercilii* lies under the occipito frontalis, and is a small, pyramidal muscle, arising from the inner extremity of the super-

ciliary ridge; its fibres proceed outward from their origin and blend with those of occipito frontalis and orbicularis palpebrarum. *Function.* It draws the eyebrows and eyelids inward, and produces the vertical wrinkles of the forehead.

The *Orbicularis Palpebrarum* (4) consists of a thin, flat plane of elliptical fibres, which extend around the whole circumference of the orbit and eyelids. It spreads outward on the temple and downward on the cheek, but the only fixed points of attachment, however, to bone are at the inner margin of the orbit. *Function.* It closes the eyelids.

The *Pyramidalis Nasi* (5) is usually regarded as a prolonged slip of the occipito frontalis, which continues downward on the bridge of the nose where it blends with the compressor nasi. *Function.* It draws down the inner angle of the eyebrows, and produces the transverse wrinkles on the bridge of the nose.

The *Levator Labii Superioris Alæque Nasi* (8) is a thin, triangular muscle, arising from the upper part of the nasal process of the superior maxilla by a pointed extremity, and, as it descends along the side of the nose, gradually increases in breadth, and then divides into two slips, one of which is inserted into the ala of the nose, and the other blends with the orbicularis oris. *Function.* It elevates the upper lip and ala of the nose, and dilates to a considerable extent the latter organ.

The *Compressor Nasi* (6) arises narrow and fleshy from the canine fossæ of the superior maxilla, and its fibres continuing upward and inward expand into a thin aponeurosis which unites on the dorsum of the nose with that of the muscle of the opposite side. *Function.* The compressors may act either as dilators or as constrictors of the nares.

Depressor Labii Superioris Alæque Nasi, covered by the orbicularis oris, arises from the myrtiform fossæ of the superior maxilla, as a short radiating muscle, whose fibres diverge upward and outward; the ascending fibres terminate in the septum and back part of the ala of the nose; the others curve forward and blend with the upper portion of the orbicularis oris. *Function.* It draws the upper lip and ala of the nose downward, and thereby constricts the anterior nares.

The *Levator Labii Superioris Proprius* (9) arises from the lower margin of the orbit, where it is attached partly to the superior maxilla, and partly to the malar bone; its fibres pass downward and inward, and blend with the upper part of the orbicularis oris. *Function.* It is the proper elevator of the upper lip, and at the same time carries it a little inward.

The *Levator Anguli Oris*, covered by the preceding and the zygomatici muscles, arises from the canine fossæ just below the infra-orbital foramen, and its fibres pass downward and outward to be inserted into

the orbicularis oris at the angle of the mouth. *Function.* It raises the angle of the mouth and draws it inward.

The *Zygomaticus, Major and Minor*, (10, 11,) arise, the latter in front of the former, from the malar bone, and then pass downward and outward to the upper lip and angle of the mouth, where their fibres blend with the orbicularis oris. *Function.* They raise the upper lip and draw the corners of the mouth outward, as in laughing.

The *Levator Labii Inferioris* (14) arises from the incisive fossæ of the lower jaw external to the symphysis; the fibres pass downward and a little forward to be inserted into the chin. *Function.* It raises and protrudes the lower lip.

The *Depressor Labii Inferioris* (12) arises from the oblique line of the inferior maxilla, just in front of the anterior mental foramen; it is a quadrilateral shaped muscle, and its fibres pass upward and outward to be inserted into the lower lip. *Function.* It draws the lower lip downward and a little outward.

The *Depressor Anguli Oris* (13) arises from the external oblique line of the lower jaw by a broad base, and its fibres converge as they pass upward to be inserted into the angle of the mouth, where they unite with the orbicularis oris, the zygomaticus major, and the levator anguli oris. *Function.* It draws the corners of the mouth downward, and is the antagonist of the muscles just named; when they all act together, the mouth is drawn backward.

The *Buccinator* (18) is a broad, thin muscle, arising from the outer border of the pterygo-maxillary ligament, and the external surface of the alveolar processes of the upper and lower jaw, commencing at the first molar tooth and passing backward. The fibres of the muscles converge, and are inserted into the angle of the mouth and the upper and lower lips. *Function.* It compresses the cheek, so as to assist mainly in driving air from the oral cavity, as in blowing on wind instruments.

The *Orbicularis Oris* (7) is a great sphincter muscle surrounding the mouth, and although it has no bony origin or insertion, as we have found, a large number of muscles arising from the different bones of the face centre here and blend their fibres with those of this muscle. *Function.* It closes the lips.

While the muscles already described as the superficial muscles of the face are mainly concerned in the varying expressions of the countenance, it must be remembered that those deep-seated muscles, the temporal, masseter, and external and internal pterygoid, which are the active agents in the comminution of food, sometimes play an important part in expression. This is markedly manifest in the aged after the loss of the dental organs, with whom the shortening of the face, the protrusion of the jaw, and the

approximation of the nose and chin, under such circumstances, are due to the contraction of these muscles and the influence which they exert in modifying the shape of the lower jaw, by altering the angle which the *ramus* forms with the body of the bone in early manhood. Considerations such as these indicate the propriety of a brief description of these muscles, in connection with the subject under consideration. The first of these,

The *Temporalis*, arises from the entire temporal fossæ and forms a broad, radiating muscle whose fibres, as they descend, converge into a flat tendon which is inserted into the inner surface of the coronoid process of the lower jaw. *Function*. It raises the lower jaw.

The *Masseter* (15) is a quadrilateral-shaped muscle, and arises from the malar process of the superior maxillæ and the zygomatic arch, and is inserted into the posterior third of the outer surface of the body of the lower jaw, and the ramus from the coronoid process to the angle. It has two planes of fibres, superficial and deep. The first pass downward and backward, the second downward and forward. *Function*. It draws the lower jaw upward and forward, or upward and backward.

The *Pterygoideus Externus* arises (1) by two heads from the pterygoid ridge of the great ala of the sphenoid bone, the outer surface of the external plate of the pterygoid process, and part of the tuberosity of the palate bone; and its fibres pass horizontally backward and outward, to be inserted (2) into the neck of the condyle of the lower jaw. *Function*. When the two muscles act together they draw the inferior maxilla directly forward, so as to make the lower front teeth project beyond those of the upper. The protrusion of the chin in those who have lost their teeth is greatly due to this fact. The lateral sliding motion of the lower jaw in mastication is effected by the alternate contraction of the muscles of the right and left sides.



The *Pterygoideus Internus*, (3,) like the masseter, is quadrilateral in form, and arises from the pterygoid fossa of the sphenoid and the tuberosity of the palate bones; its fibres pass outward, downward, and backward, to be inserted into the inner surface of the ramus and angle of the lower jaw. *Function*. It draws the lower jaw upward, and, from the obliquity of its fibres, also assists the pterygoideus externus in carrying the jaw forward and from side to side.

There are other muscles, in addition to those just described, which are somewhat concerned in expression. Among these are the depressors of

the lower jaw and the other muscles of the neck, by means of which the head is thrown into various positions, under the influence of the different passions; but it would be foreign to the subject to present even a brief description of them. It is proper, however, to refer to the ocular group of muscles, for the eye is not only one of the most prominent features of the face, but also one of the most expressive. When the rest of the face is so completely under the control of the will that it is impossible to determine what is passing in the mind of another, the eye frequently reveals everything. So true is this that, when the tongue says one thing and the eye another, men of observation and experience invariably believe the latter. It is the position of the organ, whether in the sidelong, upward, or downward glance; the fixed, prolonged gaze, or the restless, roving motion, that serves as a key, unlocking to the mind of the attentive observer that which another is striving to conceal. The muscles by which these varied movements of the organ are effected are six in number, and consist of two groups, the first of which are four straight muscles, the *Rectus Superior*, *Inferior*, *Externus*, and *Internus*; the second group is formed by two oblique muscles, the *Obliquus Superior* and *Inferior*. In addition to moving the eye upward and downward and from side to side, if all the muscles of either group act together, a retraction of the eyeball is induced by the contraction of the *Recti*, or a protrusion of the ball by similar action on the part of the oblique. Squinting or strabismus, either convergent, looking inward, or divergent, looking outward, which gives such a peculiar expression to the face, is due to a want of harmonious action in the ocular group, and may be caused by overaction or paralysis of a muscle from cerebral disturbance; or it may be the result of imitation. The *Levator Palpebra*, which is included in this group, is the elevator of the eyelid.

The muscles described, like the bony framework on which they rest, would be without motion but for their connection with the brain, through the medium of special nerves, whose function is to give to the various parts of the face that vitality and ever-changing expression which constitutes the charming attraction of the human countenance.

Of the twelve pair of cranial nerves, five pair are concerned in expression, and three of them are distributed to and give motion to the muscles of the eye. Thus the *third pair of nerves*, or the *motor oculi*, sends branches to all of these muscles, with the exception of the motor externus and the obliquus superior, to the first of which pass the *fourth pair*, or *motor externus nerve*, and the second is connected with the *sixth pair*, or *Nervus Pathetici*.

The *fifth* and *seventh pair* of nerves are distributed to the muscles of the face; the latter, also named *portio dura*, or *facial*, emerges from

the stylo-mastoid foramen, and then, passing through the parotid gland, is eventually distributed *exclusively* to the superficial muscles in the form of a plexus, named *pes anserinus*. It is purely a motor nerve, upon the integrity of which the expression of the countenance and the varied play of the features depend. This has been demonstrated in the most satisfactory manner by experiments on animals and in pathological conditions in man. Strange as it may appear now, it was formerly supposed that the painful affection named *tic Dououreux* was seated in this nerve, and resection of it at the stylo-mastoid foramen was frequently performed for the relief of patients, but with no other result than inducing paralysis of the superficial muscles and loss of expression on the side of the face operated upon, the patients being unable to close the eyelid, elevate the ala nasi, or move the cheek or that side of the lips, and yet at the same time still suffering as much from the disease. Paralysis of this nerve is sometimes induced by cerebral disturbance or the presence of a tumor beneath the ear, and is usually denominated Bell's palsy, on account of the true nature of the affection having been made known by Sir Charles Bell, to whose genius and laborious experimental research the world is greatly indebted, not only for their knowledge of this disease, but also for much that is known at present of the nervous system. Paralysis of the *Portio Dura* does not affect in the slightest degree the function of temporal masseter or pterygoid muscles, (and therefore interfere with mastication,) as they derive their nerve force from the *motor branch* of the *fifth pair*. The dependency of these muscles on the motor branch of the fifth can be readily demonstrated by divisions of the nerve on each side in animals, when the lower jaw at once falls, and the subject operated upon is rendered incapable of raising the jaw or masticating its food. If the nerve of one side only is cut, the parallelism of the jaw is destroyed; or, in other words, the muscles of the side operated upon being paralyzed, fail to bring the jaw in contact with the upper, while on the sound side it is effected as usual.

Premising that sufficient has been said with regard to the points already touched upon, we will now pass to the consideration of some of the expressions presented by the countenance when under the influence of the different passions that affect the mind of man. It is impossible to describe all of these; and the attempt, at best, in the consideration of those to which your attention will be directed, must of necessity be merely suggestive to you of an interesting and instructive subject of study, which for years has more or less intuitively engaged my attention: whether when in conversation with others, quietly observing them when engaged in the pursuit of business or pleasure; or watching the delineations of the orator, the actor, the artist; and last, though not least, the truthful revelations of the photograph.

In illustration of this part of the subject, I shall employ a number of drawings, here presented, portraying the different expressions, which are faithful copies of the admirable engravings in Sir Charles Bell's work on the Anatomy and Philosophy of Expression, and I not only cordially acknowledge the pleasure derived from the perusal of his eloquent work, but shall be most happy if in the following remarks I succeed in presenting a fair synopsis of his extended description of the subject in connection with my own observations and thoughts.

All the facial expressions may be classified under two heads—the exhilarating and the depressing; and the angle of the mouth and the inner extremities of the eyebrows as points where a number of muscles concenter are the most movable parts of the face, and on whose changes expression chiefly depend. No better illustration of this fact can be afforded than in the caricature, with which every one is familiar, representing two faces joined together, in one of which the *elevation* of the angles of the mouth gives a most joyous expression to the face; on reversing or turning the picture upside down, however, depression of the same mouth at the angles produces a correspondingly despondent expression in the other face.

Commencing with *laughter*, you will observe in this picture that the various muscles which have been described as inserted into the *orbicularis oris*, have entirely overcome the action of that muscle whose function is to close the lips. When a ludicrous idea enters the mind, as a general thing it is in vain to try to keep the mouth closed. The antagonistic muscles centering there exert a force beyond all control, and frequently the more determined the effort not to give way to the inclination, the more marked and explosive eventually becomes the demonstration. The *elevator* muscles, inserted in the upper lip and the angles of the mouth as the active agents in drawing the mouth upward, produce a fullness of the cheeks which, pressing upon the lower eyelids, throws the skin into wrinkles under them. At the same time the teeth are exposed; while by the contraction of the *orbicularis palpebrarum* the eyes are almost concealed, and, by compression of the lachrymal gland, frequently suffused with tears. Together with this, the agitation of the muscles of the throat, neck, chest, and diaphragm produce audible cacklings.

In the reverse of this, or *weeping*, the lips are drawn apart by the converging muscles, but in place of the elevation of the corners of the mouth they are now drawn downward by the *depressor anguli oris*; the nostrils, at the same time, are dilated, and the tears flow profusely from under the convulsively-closed eyelids over the flushed cheeks; while the veins of the forehead are distended and the inner part of the eyebrows are drawn upward and inward by the combined action of the *corrugator supercilii*

and the *occipito-frontalis*. The muscles of the throat, chest, and diaphragm are spasmodically affected and the respiration is frequently interrupted by sobs.

Bodily *pain*, the manifestation of which, in the face of our patients, is to us frequently an important means of diagnosis, not only in children, but those of a larger growth, is a condition that particularly claims our attention from a professional and humanitarian point of view. Here let me say, in passing, that pain is by no means what it is usually regarded, an unmixed evil. Paradoxical as the statement may appear, it is frequently a blessing rather than a curse, as it is the chief means by which we become aware that some important organ is diseased. Without such intimation, the part affected might have become disorganized to such an extent as not only to destroy the function of the organ, but also to place even life itself in jeopardy. This applies with peculiar force to those organs which it is our duty to save; for it is the unpleasant sensation of pain which generally drives our patients to us, and it is the various manifestations induced by the pain endured which enables the experienced practitioner to determine the nature and extent of the difficulty.

In extreme pain, (except in cases where the patient is suffering from periodontitis, when the occlusion of the jaws intensifies the suffering,) the teeth are brought together with great force and ground against each other by the temporal, masseter, and pterygoid muscles; the saliva frequently flows in large quantities from the mouth, which is drawn open laterally; the face is flushed, the veins distended, the nostrils dilated, the eyebrows raised, the forehead thrown into horizontal wrinkles, the eyelids widely opened, and the tears coursing over the cheeks, betray, in the most unmistakable manner, the suffering endured.

In *fear*, the head sinks backward between the elevated shoulders; the eyes are fixed and staring; the eyebrows are raised to their utmost by the *occipito-frontalis*, which, in addition to a contracted state of the scalp, causes the hair to stand on end; the face is ghastly pale, and the cheeks hollow, shrunken, and in convulsive motion, like lips which are wide open, owing to the dropping of the lower jaw; the breathing is short, labored, and spasmodic.

In *rage*, the inflamed and glaring eyeballs, owing to the contraction of the *oblique* muscles, seem ready to dart from their sockets; the brow is thrown into deep vertical wrinkles by the *corrugators*; the nostrils are dilated; while through the clinched teeth but open mouth words of hate are delivered with emphatic force.

In *joy*, the face is lighted up with a smile by the gentle elevation of the eyebrows, the lively and sparkling appearance of the eye, and the pleasant expression of the mouth, which, without being separated, is drawn aside at the corners.

Conscious of the time already absorbed, and desiring to hear from some of the gentlemen who are present from a distance, we will pass over the consideration of other facial expressions which might be referred to, trusting that those which have been so hurriedly described may awaken a desire on the part of all to acquire a thorough and accurate knowledge of the entire subject, and to make that practical application of the knowledge thus gained of which it is susceptible, but which it does not come within the province of this address to make.

THE
HUMAN TEETH
IN THEIR
RELATIONS TO MASTICATION, SPEECH, AND APPEARANCE.*

An Address delivered before the Delaware Dental Association.

GENTLEMEN:—In compliance with your appointment I appear before you this evening,—not, however, as an essayist, for my time has been so much engrossed by various duties since the nomination as to preclude the possibility of preparing a written address, but rather in an oral communication, which to me, from years of habit in the lecture-room, is decidedly preferable, to invite your attention to the consideration of the *Human Teeth in their Relations to Mastication, Speech, and Appearance*.

The varied and extended character of the subject demands that it should be treated in a general and suggestive manner; and my object in selecting it was, that it might awaken a spirit of inquiry in these various directions, and that the knowledge thus obtained might be made instrumental in securing to patients beneficial, practical results.

To prevent confusion and secure clearness of conception, it will be advisable to consider the subject under separate heads, commencing with the first.

MASTICATION.—It may be truly said that a just appreciation of the position which the human teeth occupy as masticating agents, can only be obtained by familiarity with the comparative anatomy of the dental organs; for in the structure of the teeth there are certain characteristic differences, corresponding with the habits of the animal and the kind of food upon which it subsists; and in the mouth of man teeth are found belonging to different classes of animals, whose habits and food are of the most opposite character. In illustration of this point, the craniæ of man and various animals, lying on the table, are presented.

* The illustrations accompanying this communication were engraved from specimens in my possession.—J. H. McQ.

With regard to the entire animal series, the teeth may be defined as hard organs situated on the inner surface of the digestive canal, varying in *shape, size, number, and location*, with the character of the materials which they are intended to comminute. By some animals they are employed as offensive and defensive weapons in prehension; by others, as organs of locomotion; again, they are used by certain kinds of fish in crushing the stony shells inclosing their food; as in the case of the *sheep's-head fish* and the *parrot-fish*, (*scari*.)

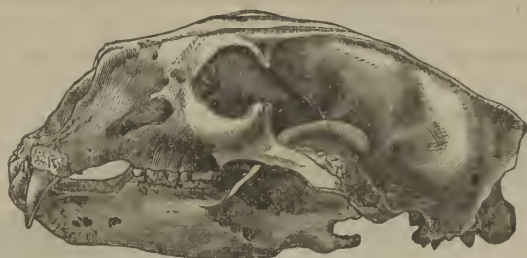
Although man and several of the animals have thirty-two teeth belonging to the permanent set, the typical number of the *vertebrates* is forty-two. Some of them, however, are *edentulous*, or without teeth; others have but one tooth, and from this they range upward to such a large number, that to those who have not examined the subject, it must appear incredible. Thus birds are found invariably *edentulous*, the gizzard serving as the comminuting organ; while at the other extreme, fish are supplied in the most liberal manner with teeth. In many of the *vertebrates* the teeth are firmly implanted in the maxillary and premaxillary bones. In other cases, as in certain kinds of fish, the teeth are inserted not merely in the maxillary and premaxillary bones, but in the palate bones, vomer, pharynx, on the tongue, and in the stomach; being so numerous, and in such peculiar positions, that it is quite difficult to count them; running as high as one hundred and forty in some, and in others to one hundred and ninety, and beyond. Wherever found, while they may subserve other purposes, they are invariably necessary agents in the prehension or comminution of food.

In fish and serpents, with the exception of the poison-fangs of venomous reptiles, the teeth are merely organs of *prehension*, and prevent the escape of the prey after being seized; and which, as a general thing, is swallowed entire.

The comparative anatomist, in making the diet a means of classification—as in the carnivorous and herbivorous animals—takes advantage of certain marked characteristics in the digestive apparatus to divide these animals. These peculiarities, however, are not confined to the dental organs only, but a constant relation is maintained between the shape and structure of the teeth; the articulation of the jaw; the form of the stomach; the length of the intestines, and the nature of the food on which the animals subsist.

Thus the teeth of the truly *carnivorous* animals are fitted to seize their prey and lacerate the food, but not to thoroughly masticate it. These organs are of three kinds, and adapted to different mechanical purposes. Thus, in the *polar bear*, the *incisors*—six in the *superior* and six in the *inferior maxillæ*—are so formed and situated as to serve as shears

in dividing the food. The *canines*—two above and two below—long, curved, and sharp-pointed tusks, possessing great strength, and deeply and firmly implanted in the jaws, are used by the animal as offensive and defensive weapons, and for seizing upon and holding its struggling prey. The *molars*—four on each side, above and below—have cutting or trenchant crowns, with serrated edges and sharp points, which are arranged in a direction parallel with the line of the jaw; and the superior teeth have a flat inner side, against which the inferior works like a scissor-blade.

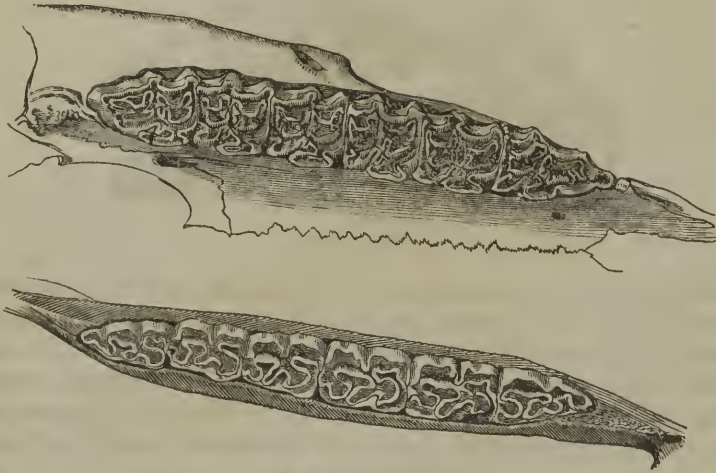


POLAR BEAR.

These teeth serve to mangle rather than thoroughly comminute the food of the animal. The jaws are strong, and the deep and narrow glenoid cavities in the temporal bones receive the condyloid processes of the inferior maxillæ in such a manner as not to admit of any horizontal motion, either backward or forward, or from side to side. This articulation, constituting the pure ginglymous, or hinge-like joint, affords the lower jaw only the upward and downward movements. In addition to this, the wide and deep temporal fossæ give an extensive origin to the immense temporal muscles inserted into the coronoid processes of the lower jaw; and the zygomatic processes are very strong and prominent, and the masseter muscles arising from them, and inserted into the rami and body of the lower jaw, are large, broad, and powerful; while the pterygo-maxillary, and pterygoid fossæ, giving origin respectively to the external and internal pterygoid muscles, are, comparatively speaking, quite shallow, and the muscles small. By this arrangement in the shape and position of the teeth, the articulation of the jaw, and the origin and insertion of the muscles, the animal is enabled to seize upon and hold its prey. Any other kind of joint, under such circumstances, would prove not merely unreliable, but actually worthless. In the carnivora the stomach is simple, and the intestinal canal is remarkably short in relation to the length of the body.

Passing to the *herbivora*, and selecting the horse as an example of this class, the *incisors*—six in number in both jaws—are arranged in a

curve at the anterior end of the jaws, and are employed as prehensile organs in seizing upon and cutting off the herbage on which the animal subsists. The *canines*, small in the horse, and rudimental in the mare, are situated in the upper jaw, in the middle of the long interspace between the incisors and molars, while in the lower jaw they are close to the outer incisors. They subserve no purpose in mastication, this being effected altogether by the *molars*,—these are six in number, for each side of the upper and lower jaws,—and the crowns of which present two double crescents, the convexity being turned inward in the upper and outward in



MOLARS OF HORSE.

the lower ones. In addition to this, the triturating surface is found to present a series of inclined planes, leading from prominent ridges to large hollow cavities lying at their base; the inequalities thus presented being due to the unequal wear of the different tissues composing the crown. The grass, either in a green or dry state, on which the herbivora subsist, containing as it does large quantities of pure silica or flint, produces decided abrasion of the teeth, particularly the molars. If the teeth, although presenting a rough masticating surface when first erupted, had been composed of only one tissue, they would soon have worn smooth, and proved inadequate to the service demanded. To meet this emergency, therefore, the different tissues composing the teeth—the enamel, dentine, and cementum—are arranged on the same plane. By such a contrivance the teeth necessarily wear unequally, and always present a rough, uneven, grinding surface to the food.

The glenoid cavities in the temporal bones of the horse and herbivorous

animals generally are quite shallow, and the condyloid processes of the lower jaw rounded. The joint thus formed not only admits of upward and downward movements, but also of extensive sliding motions in every direction. In addition to this, the temporal fossæ are quite narrow and shallow, the zygomatic processes not very prominent, and the temporal and masseter muscles arising from them are feeble, in comparison with those of the carnivora. The pterygo-maxillary and pterygoid fossæ, however, are quite deep, and the external and internal pterygoid muscles arising therefrom largely developed. By the action of these muscles the horizontal rubbing motion of the roughened surfaces of the superior and inferior molars against each other is effected, and the coarse articles of food are thoroughly triturated and reduced to a pulpy mass. One order of the herbivora—the *ruminantia*—possesses the faculty of returning the food to the mouth and subjecting it to remastication, after it has been once swallowed.



SKULL OF HORSE.

This is due to the remarkable arrangement and action of the stomach, which, as in the cow for instance, is of immense size, and divided into four compartments or stomachs. Another marked peculiarity of this order is the absence of incisors and canines in the upper jaw. The animal, when feeding, after slightly bruising the coarse vegetation by a first mastication, swallows the bolus, which passes along the œsophagus to the paunch or first stomach, and then by small portions to the second stomach, where, after being subjected to an elevated temperature for some time and mixed with the secretions, portions of it are compressed into little pellets, which successively ascend to the mouth, to be rechewed; after this is thoroughly effected, the food is again swallowed, and passes on to the third stomach, a channel being formed through the first two by the contraction of the groove or gutter made by the prolongations of the œsophagus; here it remains a certain length of time, and then passes into the fourth stomach, the true digesting organ, which is analogous to the simple stomach of animals in general.

In *man* the teeth occupy a position intermediate to those of the carnivorous and herbivorous animals. Twelve of the teeth, viz., the *canines* and the *bicuspid*s, correspond to those of the former; and twenty, the *incisors* and *molars*, to those of the latter. The *canines*, however, are much less prominent and pointed than in the carnivora; and the *molars*, while they resemble those of the herbivora, in being thick and strong and presenting comparatively flat surfaces, at the same time, in place of the curvilinear ridges of the herbivora, have more or less conical eminences like those of the carnivora.



HUMAN TEETH.

The form of the articulation of the lower jaw and the organs of digestion, not less than the teeth, present strong evidence that man is truly omnivorous, and afford a clear physiological argument in favor of the mixed animal and vegetable diet which custom and taste have decided to be natural for the human species; while the vegetarian theory, which rigidly excludes everything like animal food, under all the varying circumstances of climate and temperature, is in opposition to the indications afforded not only by the structure, but also by the practice of man. Millions, it is true, avoid flesh altogether, but millions also use it extensively. In the torrid zone there is little or no occasion for its employment, while in the cold climates, particularly in the frigid zone, it is imperatively demanded; and there is no fact more incontrovertible than that the highest order of physical and mental development is found in those countries where the inhabitants unite animal with vegetable food.

As there are cutting, tearing, and grinding teeth in man, so the articulation of the lower jaw is intermediate to those of the animal and vegetable feeder. Thus the transverse condyles of the jaw are received into the glenoid cavities, so as to admit of not only upward and downward, but also of considerable lateral or sliding motion; and the temporal, masseter, and pterygoid muscles effecting this, and the temporal fossæ, zygomatic processes, and the pterygo, maxillary, and pterygoid fossæ from which these muscles arise, hold the same intermediate relation to the animals already referred to. By this arrangement the act of mastication in man, unlike the simple laceration of the food on the part of the carnivora, can be as perfectly effected as in the herbivora; and although the articles of diet are, to a great extent, freed from impurities and softened by cooking, this should be done; for, while some human beings are in the habit of bolting their food, indulgence in such a practice is invariably followed by the most unpleasant results. The human stomach nowise resembles, as the practice of some would seem to indicate, the gizzard of birds, where hard and otherwise indigestible substances can be triturated; nor does it possess the faculty of returning imperfectly masticated food to the mouth for a second and thorough comminution, as in the ruminantia; neither is it like the stomach of the carnivora, which frequently digests with ease large portions of bone; but it is so constituted as to demand the most perfect and minute division of the food in the mouth. It is truly said that food well chewed is half digested. If, in place of this, it is swallowed in undivided masses, it becomes a source of irritation by remaining a long time undissolved in the stomach; and, if this practice is continued for any length of time, dyspepsia, with its attendant train of horrors, is evoked. The Americans, in their all-absorbing pursuit of business or pleasure, perhaps more than any other people on the globe, violate, in the most reckless manner, this canon, and, as a consequence, lantern jaws and disordered stomachs are universally presented to view. If more time was devoted to the thorough mastication of the food, in place of being time wasted, it would result in increased comfort, physical and mental *power* and *endurance*, and length of years.

Passing now to the second section of our subject, or the consideration of—

SPEECH, it will be advisable, in the first place, to define the exact difference between *voice* and *speech*; for it is a common error, even among persons of education, to speak of them as if they were one and the same thing, and yet that such is not the case will be evident on the slightest reflection.

Voice is possessed not only by man but also by all of the vertebrata having

lungs, and it results from the vibrations induced in the *vocal chords* as the air expelled from the lungs passes through the *glottis*. The sound thus created is capable of being variously modified during and after its production, and it is owing to the mutations induced by the motions of the pharynx, the velum, the tongue, the lips, and other parts of the mouth, that *speech* or *articulated voice* is produced in man, and in connection with his moral and mental endowments places him above, and gives him dominion over the brute creation, and enables him not only to make known his wants, experience, and thoughts to his fellow-man in his own day and generation, but also by the aid of the written and printed record to transmit them from age to age, thus insuring the constant and progressive development of man's moral and mental powers, and contributing to his physical comfort and well-being.

In the construction of the vocal organs in man nature appears to have combined the double mechanism of wind and string instruments, and it is on this account that it surpasses all musical instruments, by the extent, the perfection, and, above all, by the inexhaustible variety of its effects. Advantage is taken of the function of respiration to convert into a sounding instrument the passages formed by the *trachea* and *larynx*, through which the air is admitted to and expelled from the lungs. The *larynx* is a sort of cartilaginous box placed at the upper end of the trachea, and is composed of five distinct pieces, the *thyroid*, the two *arytenoid*, the *epiglottis*, and the *cricoid* cartilages, which are readily moved on each other by appropriate muscles.

The *thyroid*, which forms the upper and fore part of the larynx, consists of two lateral wings of a quadrangular shape, united in front in a longitudinal angle, which gives the prominence to the fore part of the throat, observable in men, named *prominens Adami*. From the posterior corners of the wings four processes project, which are called the superior and inferior cornua. The *cricoid* cartilage, below and behind the *thyroid*, is shaped somewhat like a signet ring, the narrow part being in front. The *arytenoid* cartilages, much smaller than these, and of a pyramidal shape, are placed one on each side on the upper posterior and lateral parts of the *cricoid*. In other words, the *cricoid* serves as a base on which the *thyroid* and the two *arytenoides* execute the motions by which the *glottis* is contracted or enlarged. The *epiglottis*, resembling the leaf of an artichoke, is attached by its base to the upper and fore part of the *thyroid*, and hangs backward over the glottis, which it closes in the act of swallowing.

These cartilages are connected with each other by ligaments, the most important and interesting of which are the *thyro-arytenoid*, which stretch from the base of the *arytenoid* cartilages to the angle between the wings

of the *thyroid*; these constitute the *vocal chords*, and the aperture between them named the *glottis*, as already stated, is the point where the breath is *vocalized*, or rendered not only sonorous but also modulated in its pitch. In the adult male the length of this fissure is from ten to eleven lines, and it is from two to three lines wide where the width is greatest. The dimensions are much less, however, in the female and in boys prior to puberty, bearing the proportion of 3:2. This is owing to the larynx of men being much larger and forming a more acute angle anteriorly. The different pitch observable in the male and female voice, and in boys is due to these variations. At puberty the larynx of boys is increased in size and changed in form, and the voice is altered. No change, however, takes place in the voice of eunuchs from whom the testes have been removed before puberty. The unsteady, bleating, and weak tone observable in the voice of old persons, is due to ossification of the cartilages of the larynx, an altered condition of the vocal chords, and loss of nervous and muscular power.

That the *voice* is produced in the *larynx* may be readily demonstrated by making an opening in the *trachea* or the *larynx* below the *glottis* in animals; this at once diverts the current of air passing from the lungs, so as to completely destroy the voice; closure of the opening, however, by forcing the air through the proper channels, restores it. If the opening is made *above* the *glottis* in man, as sometimes occurs in unsuccessful suicidal efforts at cutting the throat, the *speech* is lost but not the *voice*. Again, by blowing with the bellows a current of air through the tracheal end of the larynx of a slaughtered animal, vocal sounds can be produced, which may be varied by changing the tension of the chords.

The preceding and other analogous facts afford data for assuming that the vocal ligaments may be properly regarded as the organs of voice. In a quiescent state they do not lie parallel to each other, but for the purpose of *respiration* the aperture of the *glottis* is widely open and somewhat triangular in shape, the base of the triangle corresponding to the space between the separated *arytenoid* cartilages; the relative position of the chords, as well as their tension, however, can be varied to a considerable extent through the mobility of the *thyroid* and *arylenoid* cartilages. When, for instance, a vocal sound is made, the action commences with the contraction of certain intrinsic muscles, the *cricothyroid*, by which the vocal chords are stretched and made tense, while they are brought close to each other, and in a parallel direction, so as to reduce the aperture of the *glottis* to a mere linear fissure, by the *crico-arytenoideus lateralis* and *arytenoideus* acting upon and approximating the *arylenoid* cartilages. The air, driven by a forcible expiration through this narrow fissure, not only causes the vocal chords to vibrate, but is

itself thrown into vibrations, and thus the sound required is produced. As antagonists to the muscles named above, the *thyro-arytenoideus* relaxes the vocal chords, and the *crico-arytenoideus posticus*, by separating the *arytenoid* cartilages, opens the glottis. By such an arrangement as this in the muscles of the larynx, and the mobility of the cartilages, it is susceptible of an infinite number of changes in form, and capable of producing the finest modulations in the voice. The tone, pitch, and intensity of the different vocal sounds vary with the force of the expiratory effort, the conformation of the larynx, and the degree of tension which is given to the *vocal chords*. The greater the tension of the latter, the more frequent will be their vibrations, and the higher the pitch, or the more acute the sound; while a less degree of tension of the chords and a wider opening of the glottis will produce a grave and deeper note. For the production of the deeper notes the vocal ligaments are so much relaxed that when at rest they are wrinkled, but they become stretched by the current of air, and thus acquire the degree of tension necessary for vibration.

The force of the voice in man depends greatly on the capacity of the lungs and the volume of air which may be expelled from them in a single expiration. This is a point which claims special attention from those who are compelled to speak in public; for much of the discomfort which audiences endure in *listening* to some speakers is owing to the fact that in place of the voice being formed by a steady and uninterrupted current of air welling up in *expiration*, from lungs which were filled to their utmost capacity in *inspiration*, it is produced by the feeble expiration from organs but half inflated, in this way straining the vocal apparatus of the speaker and trying the patience of his auditory. Ignorance of this fact is the most prolific cause of so many clerical gentlemen suffering from *laryngitis*, or *clergymen's sore-throat*. Medical and other teachers often speak for a greater number of hours each week, and yet one seldom if ever hears of their being afflicted in this way, and the same is true of lawyers at the bar, and the majority of public speakers.

Such being the mode in which vocal sounds are produced in the larynx, the next step will be to consider the modifications they undergo in passing through the cavities of the pharynx, mouth, and nose, by which they become not merely vocal but *articulate* sounds, and constitute the elements of speech.

The voice, formed by the passage of the air through the glottis, acquires additional force and intensity, and becomes much more sonorous by the reverberations of the sound in the mouth and nasal cavities and the sinuses with which they communicate. When these cavities are closed by coryza, or the presence of a polypus, or the growth of other tumors, the voice is sensibly weakened and affected, so that it is said to

be nasal, though in truth it is not, for it suffers from want of the modifications which it should receive in the cavities connected with the nose. The roof of the mouth, formed by the hard and soft palate, serves as a sounding-board, on which the voice impinges, and is then driven from the mouth. (See Fig. 1.) When the palate is broad and shallow, the teeth regular and well formed, as in this skull, (see figure at page 24,) and the mouth large, there is nothing to obstruct the

Fig. 1.



passage of the voice, and under such circumstances it is generally clear and distinct, for upon the principle recognized in physics, that the angle of reflection is equal to the angle of incidence, the voice, as it wells up from the pharynx, constituting the incident wave of sound, strikes upon the palate, and the reflected wave meeting with no impediment, is driven directly from the mouth. When the palate is very high, narrow, and angular, and the teeth irregular, as in this skull, (Fig. 2,) the voice, of necessity, is materially affected. For here again applying the principles already referred to, the incident wave of sound impinging upon a *high*, narrow, and angular palate, is of course reflected, but in place of passing freely from the mouth it either strikes upon the alveolus or the palatine surfaces of the front teeth, and is then driven back to the pharynx. The resulting sound arising from this is of the most indistinct, muffled, and cavernous character, and almost unfits a person so constituted from public

speaking. The impediment which DEMOSTHENES is said to have conquered was slight in comparison with it. The application of the principles just made no doubt has suggested itself to the minds of others, but I have never heard it expressed or met with it anywhere. It is advanced for what it is worth, and without any pretentious claims to originality, as an idea which would naturally suggest itself to any thinking mind after observing the different conformation of the parts. The most distressing cases to speakers and listeners are those unfortunate persons who, either from congenital deficiencies or as the result of tertiary syphilis, have an open-

Fig. 2.



ing through the hard and soft palate. Thanks, however, to the application and ingenuity of Dr. Kingsley, of New York, this defect can now be readily obviated, and the speech made clear and distinct.

Speech, or articulated sound, as we have already seen, is a gift peculiar to man, and is the result of education and imitation. Division of these sounds has been made, on account of their origin and variations, into vowels and consonants. They are accomplished by the soft and hard palates, the teeth, tongue, lips, and cheeks, and it is important that these should be in a perfect condition to insure distinct articulation.

The *vowels*, A, E, I, O, U, are continued sounds, which the voice furnishes almost completely formed; as they need for their articulation little more than opening the mouth, at varying distances, by the separation of the jaws and lips, a slight elevation or depression of the tongue accompanying this in the pronunciation of some of the vowels.

The *consonants*, as their name indicates, serve to unite together the

vowels. Their pronunciation, affected by interruptions to the passage of the air in some parts of the oral cavity, by various and complicated motions of the lips and tongue, the latter of which, when applied to the palate or teeth, narrow or close the channel for its exit, is always less natural and more difficult than the vowels. The most harmonious languages, and the most pleasing to the ear, are those which use the *fewest consonants* and the *most vowels*. The division of the letters of the alphabet into vowels and consonants, has not been thought sufficient; but the consonants have been further distinguished according to the parts which are more especially engaged in the mechanism of their pronunciation, by the epithets dental, lingual, labial, nasal, and guttural. The special consideration of the exact action of the velum, tongue, and lips in the pronunciation of the different vowels and consonants, would involve more time than we have at our command at present; it is a subject, however, worthy of careful study on the part of the dental practitioner, and intimacy with it must impress upon him the importance and necessity of exercising the greatest care to so conduct his operations, whether upon the natural teeth or in the construction of artificial substitutes, as not to mar the speech of his patient. This would be unfortunate under any circumstances, but when occurring to one who is constantly compelled to speak or sing in public, the importance of the modification becomes immeasurably magnified. For while the improper use of the file, the inexcusable loss of a tooth, or an imperfectly constructed and badly-fitting operation, may not entirely unfit an orator, an actor, or singer, from the discharge of his duties, it is calculated to produce a modification in the speech not only perceptible to the auditory, but the recognition of that fact reacting upon the mind of the person, unfits him for the fullest development of his vocal powers.

In conclusion, it remains for us to consider the teeth in their relation to—

APPEARANCE.—This section of the subject more frequently attracts attention and excites comment on the part of ordinary observers than the portions already discussed, for even those who fail to recognize the importance of the teeth as masticatory organs, or who from physical imperfections in the auditory apparatus, or the existence of mental defects which render them incapable of distinguishing variations in sound, as a general thing at least readily notice any deviation from the ordinary appearance of the teeth. And no single feature of the face is more capable of changing the entire expression than the teeth. This is markedly evident when a classic face, which in repose excites admiration on account of the symmetry and regularity of the features and the purity of the skin, has not only the illusion dispelled at once, but a feeling of loathing in-

duced, by a smile revealing, in place of pearls, blackened and crumbling snags; while, on the other hand, a very ordinary and homely face when lighted up by a smile which uncovers clean, white, regular, and symmetrical teeth, becomes pleasing and attractive.

It is said that the teeth of Americans are more frail, and that the prevalence of dental caries, and, as a consequence, disfigured mouths, is more common with us than with Europeans and people in other parts of the world. Writers generally, in and out of the dental profession, appear disposed to adopt this as an unquestioned fact; for my own part, however, I am somewhat inclined to doubt the accuracy of this conclusion, for persons whose intelligence, keen perceptions, and clear judgment can be relied on, have informed me that when traveling through Europe they have paid special attention to this matter, and have found the teeth of the inhabitants of the countries through which they passed not merely as bad, but a great deal worse than Americans, for they do not pay that attention to the preservation, or restoration of the organs which is so universal with us.

Again, it is asserted, as an evidence of the physical degeneracy of our times, that the teeth of the present day are greatly inferior to those of preceding generations. This, however, is an open question, as the opinion merely rests upon suppositions and not reliable data. It is inferred, for instance, because hale and hearty parents and grandparents who have attained to a green old age, and retaining their teeth, in keeping with the general physical conformation, that all, or a vast majority of the teeth of the generations to which they belonged, were equally as good. It is much more reasonable, however, to believe that the same physical weakness and the operation of external influences which shortened the lives of millions who were born at the same period, produced the same effects upon the teeth of these millions, as we notice in those of our own day.

Unfortunately we have no exact data to go upon, so far as the universality of dental caries is concerned in the past; but the testimony of SHAKESPEARE, that

“—there was never yet philosopher
That could endure the toothache patiently,”

proves that it has prevailed to a greater or less extent in all time. With regard to preceding generations in our country, we have the testimony of MOORE, who, in giving a description of a party with whom he traveled through Virginia in 1802, says of one of them:—

“What a pity, blooming girl,
That lips, so ready for a lover,
Should not beneath their ruby casket cover
One tooth of pearl!
But, like a rose by the church-yard-stone,
Be doom'd to blush o'er many a mouldering bone!”

And then adds in a foot-note, "Polygnotus was the first painter, says Pliny, who showed the teeth in his portraits. He would scarcely, I think, have been tempted to such an innovation in America."

How much of this statement is to be relied upon as truthful of that period, and what allowance is to be made for the imagination of the poet, and the disposition to satirize a people whom he neither understood nor admired, is now difficult to determine. In whatever way we accept the testimony, it is at least evident that our teeth have not become worse; but, on the contrary, it is rather to be hoped that on account of the attention which they now receive in contrast to a former period, when there were few if any skillful dental practitioners, that they have rather improved than otherwise.

To whatever extent dental caries may prevail within our own country or elsewhere, there is no face, however beautiful or homely, that is not more or less affected by the condition of the teeth; to this end therefore it is important that irregularities of the teeth should be corrected, if no other reasons existed in favor of such efforts; and that every exertion should be put forth to save the natural organs when affected by decay. For to do this is the highest order of surgery, and in all, but very rare and exceptional cases, artificial substitutes, however perfectly constructed, fail to entirely restore the lost expression. It is not enough, however, to merely save the teeth, but the aim should be to preserve, so far as it is possible, the natural form and size of the organs, and to so conduct, and construct the operations as to make the least possible exhibition of them when the patient opens his mouth. However gratifying it may be to the pride of a dentist to have his work made evident to all men in this way, if an operation or a series of operations have been accomplished at an *unnecessary* and *unjustifiable* loss of the anatomical characteristics of the teeth and a great part of their utility as masticatory organs, the work, however beautiful to look upon as a mere piece of handicraft, cannot be regarded as in the fullest sense a complete success, or as a course which should be commended or adopted by others. There are cases in which the operations, on account of the extensive ravages of decay and the portion of the tooth affected, must show. To these, of course, the remark just made has no reference.

The general appearance of the face is not merely affected by the condition, presence, or absence of the front teeth, but the hollow, sunken cheek reveals in the most unmistakable manner the loss of bicuspids and molars. The symmetry of the face in this way is frequently destroyed by the inexcusable extraction of these teeth because a proper valuation is not placed upon them as masticatory organs, and on the score of appearance, by practitioners and patients, it being supposed that, as back teeth, their

absence will never be noticed. As an illustration of the effect sometimes produced by the adoption of such a course, observe this skull, in which you see that the orbit, the malar, and superior maxillary bones on the left side are very much depressed or lowered in comparison with the right side; and this, beyond a question of doubt, is due to the extraction of the left inferior molars, and must have given a very singular expression to the person during life. There are very few faces, when examined critically, in which both sides will be found symmetrical, or in harmony with each other. One side, for instance, will be round and full, and the other hollow and sunken; after making every allowance for congenital defects, falls, blows, and other accidents, in the majority of these cases the variation or deformity, for it often amounts to that, has been caused by the loss of molars and bicuspid, many of which might have been saved if their true value had been duly appreciated.

In the introduction of artificial teeth, the greatest care of course should be exercised to preserve or restore the natural appearance of the face. To do this with any prospect of success, however, it is important that the anatomy and physiology of expression should be made a careful object of study.

It is important, for instance, that the teeth should be so arranged as not to give a sunken appearance to the mouth, or to make it so prominent as to obliterate the groove or depression in the middle of the upper lip; the concavity which naturally belongs to the space between the lower lip and chin; and the lines which the action of the muscles create on each side of the mouth, extending from the wings of the nose to the corners of the lips.



